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Bayesian combination of multisensor precipitation measurements for flood forecasting

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The assessment and reduction of uncertainty in flood forecasting requires reliable quantitative and spatial descriptions of the rainfall field.

The paper presents a Bayesian technique for merging weather RADAR, weather Satellite and raingauge derived rainfall data. The technique is based upon the use of Block Kriging and Kalman filtering. It combines optimally, in a Bayesian sense, point raingauge measurements and areal rainfall estimates.

The Bayesian combination technique comprises an original Block Kriging approach to the problem of spatial interpolation, which also includes a new formulation of Kriging with uncertain precipitation measurements. A Maximum Likelihood estimator is used to estimate the semi-variogram parameters in real-time, thus avoiding the typical Block Kriging smoothing. A Kalman filter is used to combine Block Kriging, RADAR and Satellite rainfall estimates, using real-time updatings of their covariance error matrixes. In the end, a nontrivial simplification of the Rauch-Tung-Striebel (RTS) fixed interval smoothing algorithm is used to solve the downscaling problem and producing rainfall estimates at a spatial scale suitable for hydrologic applications.

Two case studies are presented, on the Reno River in Italy and on a mountainous area in the Austrian Alps. The case studies show an example of the improvements in the detection of rainfall spatial distribution obtained by means of the proposed technique.